

Humans and Aerospace
Humans and Automation Question

Historically, astronauts that have flown in space as part of NASA's human spaceflight program have been in excellent physical condition with very few, if any chronic medical conditions. This was important when it was unclear what acute and chronic effects exposure to the space environment would have on the human performance and in allowing engineers to minimize the risk of medical and operational emergencies during longer duration spaceflight missions. However, there now appears to be a paradigm shift toward flying a greater number of individuals with chronic medical conditions in space, in both the astronaut corp. and through the burgeoning commercial spaceflight industry. With this new interest and near-term possibility of flying less healthy individuals, it is imperative that human systems considerations for this new population of people be systematically monitored and evaluated.

- I. (20%) It is unclear what the difference in variability is for this new 'astronaut' population with respect to the healthy astronauts that previously have flown. Please discuss the effects of the space environment on a human and how expanding baseline requirements is related to monitoring performance.

- II. (40%) In these extreme environments, astronauts are expected to perform tasks that add physical and mental stress to their cardiovascular system. In this question you will **design a study** to examine the synergistic effects of circadian misalignment and physical and/or mental stressors on cardiovascular function for an operational task involving manual descent and landing on the Martian surface. Specifically address:
 - a. The definition of your study population(s) and why they were selected
 - b. The physical and/or mental task(s) selected and why they were selected
 - c. Discuss how you could assess workload and situational awareness for the given operational task.
 - d. Your null and alternative hypotheses for the study.

- III. (40%) The year is 2075, and the United States is in the process of establishing a long-duration presence on Mars. The first three Martian descent and landings were executed manually.
 - a. What are your specific recommendations for improving pilot response to off-nominal and unexpected circumstances for manual landing? Describe different classes of breakdown in situational awareness and two different methods for assessing situational awareness.
 - b. There is now interest in performing autonomous resupply of the base. In support of these future missions, NASA is now planning to introduce automation to support precision landing. What is one of the primary dangers to introducing automation with control authority? What are some ways you can mitigate this concern?